

1 13. A flywheel^{assembly} for a power transmission system for
2 transmitting engine torque to a driven unit, comprising:
3 an elastic plate secured to a crankshaft to rotate
4 therewith;
5 a flywheel body secured to said elastic plate and having
6 ^{engaging} an engageable surface for engaging with a clutch disc; and
7 a reinforcing member for reinforcing said elastic plate
8 at a portion of said elastic plate which is secured to said
9 crankshaft;
10 said elastic plate having an axial rigidity in the range
11 of 600 kg/mm to 2200 kg/mm so as to ensure transmission of
12 engine torque ^{through said flywheel assembly} to said driven unit, while decreasing noise
13 produced by a bending vibration of said crankshaft;
14 wherein said elastic plate is clamped ^{axially} between said
15 reinforcing member and a shaft end of said crankshaft, said
16 flywheel body comprises a central hole, and said reinforcing
17 member is received concentrically in said central hole,
18 ^{with a clearance allowing} ^{to move} whereby said flywheel body is ~~movable~~ axially relative to said
19 reinforcing member during operation.

1 14. A flywheel^{assembly} for a power transmission system for
2 transmitting engine torque to a driven unit, comprising:
3 an elastic plate secured to a crankshaft to rotate

4 therewith;

5 a flywheel body secured to said elastic plate and having
6 ^{engaging} an engageable surface for engaging with a clutch disc; and

7 a reinforcing member for reinforcing said elastic plate
8 at a portion of said elastic plate which is secured to said
9 crankshaft;

10 said engageable surface having an axial run-out which is
11 equal to or less than 0.1 mm;

12 wherein said elastic plate is clamped ^{axially} between said
13 reinforcing member and a shaft end of said crankshaft, said
14 flywheel body comprises a central hole, and said reinforcing
15 member is received concentrically in said central hole,
16 ^{with a clearance allowing} ^{to move} whereby said flywheel body is movable axially relative to said
17 reinforcing member during operation.

1 15. A flywheel assembly comprising:

2 ^{crankshaft} a ~~driving shaft~~ (1) for transmitting torque;

3 a circular elastic ^{plate} member (2) comprising an outer portion
4 and an inner portion and extending radially inwardly from said
5 outer portion to said inner portion, said inner portion of

6 said elastic ^{plate} member being fastened to a shaft end of said
7 ^{crankshaft} ~~driving shaft~~;

8 an annular flywheel ^{body} member (5) comprising an outer

9 portion and an inner portion and extending radially inwardly
10 from said outer portion to said inner portion of said flywheel
11 member, said outer portion of said flywheel ^{body}~~member~~ being
12 fastened to said outer portion of said elastic ^{plate}~~member~~, said
13 inner portion of said flywheel ^{body}~~member~~ comprising a central
14 circular hole; and

15 a reinforcing member (4) comprising a cylindrical portion
16 (4a) axially extending from a first ^{member}~~end~~ to a second ^{member}~~end~~, an
17 inner portion extending radially inwardly from said first end
18 of said cylindrical portion, said inner portion of said
19 reinforcing member being fastened to said shaft end of said
20 ~~crankshaft~~ ~~driving shaft~~, said cylindrical portion of said reinforcing
21 member being fit in said circular hole of said flywheel ^{body}~~member~~
22 with a clearance to form a loose fit;

23 wherein said inner portion of said elastic ^{plate}~~member~~ is
24 fixedly clamped between said shaft end of said driving shaft
25 and said inner portion of said reinforcing member, said inner
26 portion of said flywheel ^{body}~~member~~ is ~~loosely~~ fit over said
27 cylindrical portion of said reinforcing member, and said
28 reinforcing member allows axial movement of said inner portion
29 of said flywheel body relative to said inner portions of said
30 elastic ^{plate}~~member~~ and said reinforcing member.

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16. A flywheel assembly for a power transmission system for transmitting engine torque ~~to a driven unit~~, comprising:

a crankshaft;

an elastic plate comprising an inner portion secured to a shaft end of said crankshaft;

a flywheel body secured to said elastic plate and having an ^{engaging} ~~engageable~~ surface for engaging with a clutch disc; and

a reinforcing member for reinforcing said elastic plate at said inner portion of said elastic plate;

wherein said elastic plate has an axial rigidity in the range of 600 kg/mm to 2200 kg/mm so as to ensure transmission of engine torque ^{through said flywheel assembly} ~~to said driven unit~~, while decreasing noise produced by a bending vibration of said crankshaft; and

wherein said elastic plate is clamped ^{axially} ~~between~~ said reinforcing member and said shaft end of said crankshaft.

17. A flywheel assembly as set forth in Claim 16, wherein said flywheel body comprises an inner portion defining a circular central hole, and an outer portion surrounding said inner portion of said flywheel body; said elastic plate comprises an outer portion which surrounds said inner portion of said elastic plate and which is fixed to said outer portion of said flywheel body; said reinforcing member is fit in said

8 central hole of said flywheel body with a clearance to form a
9 loose fit; and said reinforcing member comprises a ^{an} smooth
10 outer circumferential surface for allowing said inner portion
11 of said flywheel body to move axially to said elastic plate
12 without limiting an axial movement of the inner portion of said
13 flywheel body toward said elastic plate.

1 18. A flywheel assembly as set forth in Claim 17,
2 wherein said reinforcing member extends axially from a first
3 member end defined by a radially extending abutment surface
4 held in contact with said elastic plate, to a second member
5 end; said ~~smooth~~ outer circumferential surface of said
6 reinforcing member extends smoothly from said abutment surface
7 toward said second member end of said reinforcing member; said
8 ~~smooth~~ outer circumferential surface of said reinforcing
9 member comprises an outer cylindrical surface section fit in
10 said central hole of said flywheel body, and an outer ~~smooth~~
11 curved surface section which extends continuously and ~~smoothly~~
12 from said outer cylindrical surface section to said abutment
13 surface; and said ~~smooth~~ curved surface section is a surface
14 of revolution whose diameter decreases ^{continuously} smoothly from a
15 diameter of said cylindrical surface section toward said
16 abutment surface.

1 19. A flywheel assembly as set forth in Claim 18,
2 wherein said flywheel body comprises a side surface facing
3 toward said elastic plate, and said ^{engaging}~~engageable~~ surface which
4 faces away from said elastic plate and which extends in an
5 imaginary flat ^{plane}~~surface~~; and said second member end of said
6 reinforcing member is located axially between said ^{engaging}~~engageable~~
7 surface and said side surface of said flywheel body and away
8 from said imaginary flat ^{plane}~~surface~~.

1 20. A flywheel assembly as set forth in Claim 16,
2 wherein said flywheel body comprises an inner portion defining
3 a circular central hole, and an outer portion surrounding said
4 inner portion of said flywheel body; said elastic plate
5 comprises an outer portion which surrounds said inner portion
6 of said elastic plate and which is fixed to said outer portion
7 of said flywheel body; and said reinforcing member comprises
8 ^a~~a smooth~~ outer circumferential surface allowing said inner
9 portion of said flywheel body to move axially toward said
10 elastic plate without limiting an axial movement of the inner
11 portion of said flywheel body toward said elastic plate.

1 21. A flywheel assembly as set forth in Claim 16,
2 wherein said flywheel body comprises a side surface facing

3 toward said elastic plate, and said ^{engaging}engageable surface which
4 faces away from said elastic plate; and said reinforcing
5 member comprises a radially extending abutment surface held in
6 contact with said elastic plate, and ^{an}a ~~smooth~~ outer
7 circumferential curved surface which extends continuously ~~and~~
8 ~~smoothly~~ from said abutment surface to a curved surface end
9 which is located axially between said side surface of said
10 flywheel body and said ^{engaging}engageable surface of said flywheel
11 body.

1 22. A flywheel assembly as set forth in Claim 21,
2 wherein said ~~smooth~~ outer circumferential curved surface of
3 said reinforcing member is a surface of revolution whose
4 diameter increases ^{continuously}~~smoothly~~ from said abutment surface of said
5 reinforcing member to said curved surface end of said ~~smooth~~
6 outer circumferential curved surface.

a 1 23. A flywheel assembly as set forth in Claim 21,
2 wherein said reinforcing member extends axially from a first
3 member end defined by said abutment surface to a second member
4 end which is located axially between said ^{engaging}engageable surface
5 and said side surface of said flywheel body; and an axial
6 distance of said second member end of said reinforcing member

7 from said abutment surface of said reinforcing member is
8 smaller than an axial distance of said ^{engaging}~~engagement~~ surface of
9 said flywheel body from said abutment surface of said
10 reinforcing member.

1 24. A flywheel assembly as set forth in Claim 21, said
2 ^{engaging}~~engageable~~ surface of said flywheel body extends in an
3 imaginary flat ^{plane}~~surface~~; and said reinforcing member extends
4 axially from a first member end defined by said abutment
5 surface to a second member end which is located axially
6 between said ^{engaging}~~engageable~~ surface and said side surface of said
7 flywheel body and which is away from said imaginary flat
8 ^{plane}~~surface~~.

1 25. A flywheel assembly as set forth in Claim 24,
2 wherein said flywheel body comprises an inner portion defining
3 a circular central hole, and an outer portion surrounding said
4 inner portion of said flywheel body; said elastic plate
5 comprises an outer portion which surrounds said inner portion
6 of said elastic plate and which is fixed to said outer portion
7 of said flywheel body; said reinforcing member comprises a
8 received portion which is received in said central hole of
9 said flywheel body; and said outer ~~smooth~~ curved surface of

10 said reinforcing member extends ~~smoothly and~~ continuously from
11 said abutment surface to said received portion.

1 26. A flywheel assembly as set forth in Claim 25,
2 wherein said received portion of said reinforcing member
3 comprises a cylindrical outside surface received in said
4 central hole of said flywheel body, and the diameter of said
5 ~~smooth~~ curved surface increases ~~smoothly and~~ continuously from
6 said abutment surface to a diameter of said cylindrical
7 surface of said reinforcing member.

1 27. A flywheel assembly as set forth in Claim 24,
2 wherein said axial rigidity is in the range of 600 kg/mm to
3 1700 kg/mm.

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1 28. A flywheel assembly as set forth in Claim 24,
2 wherein an axial run-out of said ^{engaging} ~~engageable~~ surface when
3 rotated by said crankshaft is no more than 0.1 mm.

1 29. A flywheel assembly as set forth in Claim 28,
2 wherein said ^{engaging} ~~engageable~~ surface of said flywheel body is
3 formed so as to make the axial run-out no more than 0.1 mm by
4 ^{engaging} ~~engageable~~ processing said ~~engageable~~ surface of said flywheel body in an

5 assembled state in which said crankshaft, said elastic plate,
6 said flywheel body and said reinforcing member are assembled
7 in a unit.

1 30. A flywheel assembly as set forth in Claim 24,
2 wherein said side surface of said flywheel body comprises an
3 outer side surface section which faces toward said elastic
4 plate and which is fastened to an outer portion of said
5 elastic plate and an inner side surface section which faces
6 toward said elastic plate, which is surrounded by said outer
7 side surface section of said flywheel body, and which is
8 raised from said outer side surface section axially toward
9 said elastic plate.

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1 31. A flywheel assembly for a power transmission system
2 for transmitting engine torque to a driven unit, comprising:
3 a crankshaft;
4 an elastic plate comprising an inner portion secured to
5 a shaft end of said crankshaft;
6 a flywheel body secured to said elastic plate and having
7 an ^{engaging}engageable surface for engaging with a clutch disc; and
8 a reinforcing member for reinforcing said elastic plate
9 at said inner portion of said elastic plate;

10 engaging
 wherein said engageable surface has an axial run-out
11 which is no more than 0.1 mm; and
12 wherein said elastic plate is clamped ^{axially} between said
13 reinforcing member and said shaft end of said crankshaft.

1 32. A flywheel assembly as claimed in Claim 31, wherein
2 said flywheel body comprises an inner portion defining a
3 circular central hole, and an outer portion surrounding said
4 inner portion of said flywheel body; said elastic plate
5 comprises an outer portion which surrounds said inner portion
6 of said elastic plate and which is fixed to said outer portion
7 of said flywheel body; said reinforcing member is fit in said
8 central hole of said flywheel body with a clearance to form a
9 loose fit; and said reinforcing member comprises ^{an} a smooth
10 outer circumferential surface for allowing said inner portion
11 of said flywheel body to move axially to said elastic plate
12 without limiting an axial movement of the inner portion of said
13 flywheel body toward said elastic plate.

1 33. A flywheel assembly as set forth in Claim 32,
2 wherein said reinforcing member extends axially from a first
3 member end defined by a radially extending abutment surface
4 held in contact with said elastic plate, to a second member

5 end; said ~~smooth~~ outer circumferential surface of said
6 reinforcing member extends ^{continuously} ~~smoothly~~ from said abutment surface
7 toward said second member end of said reinforcing member; said
8 ~~smooth~~ outer circumferential surface of said reinforcing
9 member comprises an outer cylindrical surface section fit in
10 said central hole of said flywheel body, and an outer ~~smooth~~
11 curved surface section which extends continuously and ~~smoothly~~
12 from said outer cylindrical surface section to said abutment
13 surface; and said ~~smooth~~ curved surface section is a surface
14 of revolution whose diameter decreases smoothly from a
15 diameter of said cylindrical surface section toward said
16 abutment surface.

1 34. A flywheel assembly as set forth in Claim 33,
2 wherein said flywheel body comprises a side surface facing
3 toward said elastic plate, and said ^{engaging} ~~engageable~~ surface which
4 faces away from said elastic plate and which extends in an
5 imaginary flat ^{plane} ~~surface~~; and said second member end of said
6 reinforcing member is located axially between said engageable
7 surface and said side surface of said flywheel body and away
8 from said imaginary flat ^{plane} ~~surface~~.

1 35. A flywheel assembly as set forth in Claim 31,

2 wherein said flywheel body comprises an inner portion defining
3 a circular central hole, and an outer portion surrounding said
4 inner portion of said flywheel body; said elastic plate
5 comprises an outer portion which surrounds said inner portion
6 of said elastic plate and which is fixed to said outer portion
7 of said flywheel body; and said reinforcing member comprises
8 a ^{an} ~~smooth~~ outer circumferential surface allowing said inner
9 portion of said flywheel body to move axially toward said
10 elastic plate without limiting an axial movement of the inner
11 portion of said flywheel body toward said elastic plate.

1 36. A flywheel assembly as set forth in Claim 31,
2 wherein said flywheel body comprises a side surface facing
3 toward said elastic plate, and said ^{engaging} ~~engageable~~ surface which
4 faces away from said elastic plate; and said reinforcing
5 member comprises a radially extending abutment surface held in
6 contact with said elastic plate, and a ^{an} ~~smooth~~ outer
7 circumferential curved surface which extends continuously and
8 ~~smoothly~~ from said abutment surface to a curved surface end
9 which is located axially between said side surface of said
10 flywheel body and said ^{engaging} ~~engageable~~ surface of said flywheel
11 body.

1 37. A flywheel assembly as set forth in Claim 36,
2 wherein said ~~smooth~~ outer circumferential curved surface of
3 said reinforcing member is a surface of revolution whose
4 diameter increases ^{continuously} ~~smoothly~~ from said abutment surface of said
5 reinforcing member to said curved surface end of said ~~smooth~~
6 outer circumferential curved surface.

1 38. A flywheel assembly as set forth in Claim 36,
2 wherein said reinforcing member extends axially from a first
3 member end defined by said abutment surface to a second member
4 end which is located axially between said ^{engaging} ~~engageable~~ surface
5 and said side surface of said flywheel body; and an axial
6 distance of said second member end of said reinforcing member
7 from said abutment surface of said reinforcing member is
8 smaller than an axial distance of said engagement surface of
9 said flywheel body from said abutment surface of said
10 reinforcing member.

1 39. A flywheel assembly as set forth in Claim 36, said
2 ^{engaging} ~~engageable~~ surface of said flywheel body extends in an
3 imaginary flat ^{plane} ~~surface~~; and said reinforcing member extends
4 axially from a first member end defined by said abutment
5 surface to a second member end which is located axially

6 engaging
7 between said engageable surface and said side surface of said
8 flywheel body and which is away from said imaginary flat
9 plane
10 surface.

1 40. A flywheel assembly as set forth in Claim 39,
2 wherein said flywheel body comprises an inner portion defining
3 a circular central hole, and an outer portion surrounding said
4 inner portion of said flywheel body; said elastic plate
5 comprises an outer portion which surrounds said inner portion
6 of said elastic plate and which is fixed to said outer portion
7 of said flywheel body; said reinforcing member comprises a
8 received portion which is received in said central hole of
9 said flywheel body; and said outer smooth curved surface of
10 said reinforcing member extends smoothly and continuously from
11 said abutment surface to said received portion.

1 41. A flywheel assembly as set forth in Claim 40,
2 wherein said received portion of said reinforcing member
3 comprises a cylindrical outside surface received in said
4 central hole of said flywheel body, and the diameter of said
5 smooth curved surface increases smoothly and continuously from
6 said abutment surface to a diameter of said cylindrical
7 surface of said reinforcing member.

1 42. A flywheel assembly as set forth in Claim 39,
2 ^{engaging}
3 wherein said ~~engageable~~ surface of said flywheel body is
4 formed so as to make the axial run-out no more than 0.1 mm by
5 ^{engaging}
6 processing said ~~engageable~~ surface of said flywheel body in an
7 assembled state in which said crankshaft, said elastic plate,
 said flywheel body and said reinforcing member are assembled
 in a unit.

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